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NASA TECH BRIEF

Lyndon B. Johnson Space Center

In-Process Oxidation Protection in Fluxless Brazing or Diffusion Bonding of Aluminum Alloys

The problem:

The joining of aluminum and its alloys poses a peculiar problem. When exposed to the atmosphere, both aluminum and its alloys quickly form a thin oxide coating which serves as protection against further corrosion. During a joining process, however, this coating interferes with the formation of strong joints. The coating is refractive in nature and remains as an impervious wall even at high temperatures, encasing molten aluminum to prevent wetting and proper joining. Present techniques in the cleaning of aluminum provide insufficient prevention against further oxide formation and require special and expeditious handling between cleaning and joining.

The solution:

In a new technique aluminum is cleaned of its oxide coating and is sealed immediately with a polymeric material, making it suitable for fluxless brazing or diffusion bonding. The time involved between cleaning and brazing is no longer a critical factor.

How it's done:

In preparing aluminum or aluminum alloy parts for fluxless brazing or diffusion bonding, the surfaces to be joined first are cleaned thoroughly of any grease. Any common degreasing agent may be used, such as naptha, liquid chlorinated hydrocarbons, or any one of a number of petroleum distillates.

Following degreasing, the aluminum oxide coating is removed by a chemical cleaning technique. One of the better removal methods involves subjecting the metal surface to successive alkali and acid washings. Solutions of virtually any alkali metal hydroxides can be used, preferably sodium hydroxide and sodium bicarbonate, in amounts varying from about 1 to 10 grams of each per liter of solution. During this stage, the solution is maintained at elevated temperatures between 150° to 200° F (65° to 92° C), and cleaning is continued for approximately 1 to 10 minutes. The cleaned surfaces then are rinsed with hot water, approximately 140° to 160° F (59° to 70° C).

Practically any mineral acid, such as sulphuric, hydrochloric, or nitric acid, can be used in the acid washing step. The precise concentration of acid solution is not critical, the sole requirement being sufficient acid to dissolve the aluminum hydroxide formed in the caustic washing. In general, the acid solution should be diluted 1 to 1 in water. Cleaning time is approximately 1 to 10 minutes, depending on the size of the aluminum surface.

After the acid treatment, the aluminum is rinsed in distilled water. It then is immersed in an organic solvent, miscible with water, such as acetone to remove all water from the surfaces. Immediately following this step, the clean surfaces to be welded are coated with a sealer.

The sealer used may be any polymeric material which prevents substantial permeation of oxygen to the coated surface and which can be volatilized from the surface during the joining process, leaving essentially no residue. One of the better sealers comprises 5 grams of polystyrene in 500 milliliters of toluene and 250 milliliters of acetone. Sealed aluminum surfaces then can be stored for several days without any appreciable surface oxidation.

Note:

This technique is described in the following report:
"Fabrication Process Scale-Up and Optimization for a Boron Aluminum Composite Radiator"
Reference:NASA CR-128805 (N73-19468).

This report may be obtained from:
National Technical Information Service
Springfield, Virginia 22151
Single document price $8.75
(or microfiche $1.45)

(continued overleaf)

Patent status:

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning non-exclusive or exclusive license for its commercial development should be addressed to:

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